REMARKS

Claims 1-5 are currently pending. Claim 1 is the only independent claim.

In the Office Action, the Examiner:

rejected claims 1-5 under 35 USC § 103(a) as being unpatentable over Murphy et al. (US 6,352,662) in view of Nelson et al. (US 6,143,236) and further in view of Renaudin et al. (US 6,071,460); and

rejected claims 1-5 under 35 USC § 103(a) as being unpatentable over Murphy in view of Lunde et al. (US 6,692,681) and further in view of Renaudin.

Applicants thank the Examiner for the courtesy of the telephonic interview on December 1, 2006, in which Applicants' representative and the Examiner discussed the present invention and the cited prior art references Murphy, Nelson and Renaudin. Agreement was not reached, particularly with respect to the teachings of Renaudin, either alone or in combination with the other cited references. Applicants' representative indicated that a response would be filed.

Attached hereto, are two pages of explanation, with figures, of the present invention and the prior art, as provided to Applicants' representative by Applicants.

Claim 1, which is directed to a method for forming a hollow FRP article by internal pressure molding, recites, in part, the steps of:

"inserting a composite body including said internal-pressure holding tube and said prepreg into a vacuum chamber containing a forming; die,"

"inserting a composite body including said internal-pressure holding tube and said prepreg into a vacuum chamber containing a forming; die,"

"evacuating said vacuum chamber in an isolation state where said composite body and said forming die do not contact each other," and

"clamping said forming die to bring said forming die and said composite body into contact with each other ... after completion of said evacuating step."

The present invention solves the problem of irregularities (i.e. pits and dimples) formed on the surface of an internal pressure molded part due to air remaining in the space between the external forming die and the surface of the pre-

preg part (specification, page 3). According to the present invention, a composite body, which includes a holding tube and a prepreg, is inserted into a vacuum chamber, which contains an unclamped forming die. The vacuum chamber is evacuated. The composite body and the forming die do not contact each other during this evacuation of the vacuum chamber. After completion of the evacuation of the vacuum chamber, the forming die is clamped such that the forming die and the composite body now contact each other.

With respect to the rejection of claim 1 as being unpatentable over Murphy in view of Nelson and Renaudin, the Examiner asserts that Murphy discloses wrapping a mandrel with a bladder and fiber-reinforced plies and placing the wrapped mandrel in a mold. According to the Examiner, Murphy fails to teach applying a vacuum such that the fiber-reinforced plies do not contact the mold. The Examiner cites to Nelson for its disclosure of drawing a vacuum onto a mold after the mold is closed and prior to pressurizing a bladder. According to the Examiner, Murphy in combination with Nelson fails to teach that the fiber reinforced pre-preg plies are not in contact with the mold. The Examiner cites to Renaudin for teaching an internal pressure molding process for making a fiber composite shaft including allowing for a gap to exist between the internal mold surface and the pre-preg plies (referring to Fig. 6A).

Murphy discloses wrapping a mandrel with a bladder and a plurality of pre-preg plies, placing the wrapped assembly within a mold and pressurizing the pre-preg plies outward against the mold by introducing a pressurized gas through the mandrel. (See Murphy, col. 3, ll. 5-25). Murphy fails to disclose applying a vacuum. Murphy fails to disclose a vacuum chamber.

Nelson discloses placing a pre-preg wrapped bladder into a mold, closing the mold and then pressurizing the bladder. A vacuum may be applied after the mold is closed and before the bladder is pressurized (col. 4, lines 55-56). Nelson further discloses that the pre-preg wrapped bladder is placed into a female mold (col. 4, lines 45-47), thereby teaching that even before pressurization of the bladder and/or pulling a vacuum in the mold, the pre-preg is in contact with the mold. In other words, when the vacuum is applied, the pre-preg plies are already contacting the

mold. Further, when the vacuum is applied, the mold is already closed (i.e. clamped). Additionally, Nelson fails to teach that the mold and the pre-preg are within a vacuum chamber, as Nelson teaches that the vacuum is created within the mold itself (see FIG. 14B and vacuum port 311).

Renaudin discloses an inflatable bladder positioned over a mandrel and then fiber layers placed over the bladder. The mandrel/bladder/fiber assembly is placed in a mold with the bladder unpressurized or deflated such that a gap d_2 exists between the mold and the outer fiber layers of the composite structure (see e.g. Figs. 6A and 6B; col. 8, lines 45-63). In a subsequent step, the bladder is expanded within the mold so that the fiber layers of the composite structure are compressed between the bladder and the mold (see e.g., Abstract and Figs. 8 and 9). Referring to Figs. 8 and 9, Renaudin discloses that, in an expansion step, pressure is applied to the bladder causing the bladder to expand and compress the structure against the surface of the mold. During expansion, the composite structure undergoes a displacement d_2, corresponding to the size of the gap. (Col. 9, lines 11-14.) In other words, Renaudin teaches that the gap d_2 disappears when the bladder is inflated. Furthermore, Renaudin fails to disclose pulling a vacuum at any time during the molding process. Even if the Examiner were to equate pressurizing the Renaudin bladder with pulling a vacuum, which Applicants dispute, Renaudin fails to disclose pressurizing the bladder and at the same time maintaining the gap between the composite structure and the mold surface, such that the composite structure and the mold do not come into contact with each other.

Claim 1 requires that when the vacuum chamber, which contains the composite body and the unclamped forming die, is evacuated, the composite body and the forming die do not contact each other.

- Murphy fails to teach applying a vacuum at any stage of the process.
- Nelson teaches applying a vacuum to the closed molding die within which the pre-preg preform has been placed. Prior to and during application of the vacuum the outer surface of the pre-preg preform contacts the surfaces of the molding die.
- Renaudin fails to disclose applying a vacuum during the molding process.

Thus, Applicants submit that there is no teaching, suggestion or motivation in any of these cited references, either alone or in combination, for "evacuating said vacuum chamber in an isolation state where said composite body and said forming die do not contact each other," as required by claim 1.

Additionally, claim 1 requires clamping the forming die to bring the forming die and the composite body into contact with each other ... after completion of the evacuating step.

- Murphy fails to teach applying a vacuum at any stage of the process.
- Nelson teaches applying a vacuum to the closed molding die within which the pre-preg preform has been placed, during which application of the vacuum the outer surface of the pre-preg preform contacts the surfaces of the molding die. Thus, Nelson teaches closing the mold before the evacuation of the mold.
- Renaudin fails to disclose applying a vacuum during the molding process.

Thus, Applicants submit that there is no teaching, suggestion or motivation in any of these cited references, either alone or in combination, for "clamping said forming die to bring said forming die and said composite body into contact with each other ... after completion of said evacuating step," as required by claim 1.

Even further, claim 1 requires inserting a composite body including said internal-pressure holding tube and said prepreg into a vacuum chamber containing a forming die.

- Murphy fails to teach a vacuum chamber.
- Nelson teaches that the closed mold, itself, is the vacuum chamber. Thus, Nelson fails to teach that the vacuum chamber contains the forming die.
- Renaudin fails to teach a vacuum chamber.

Thus, Applicants submit that there is no teaching, suggestion or motivation in any of these cited references, either alone or in combination, for "inserting a composite body including said internal-pressure holding tube and said prepreg into a vacuum chamber containing a forming die," as required by claim 1.

Since all of the limitations of Applicants' claim 1 are not taught or suggested by the combination of Murphy, Nelson and Renaudin, claim 1 is not obvious under

35 USC § 103(a) over this combination. Accordingly, the rejection of claim 1 under 35 USC § 103(a) should be withdrawn.

With respect to the rejection of claims 1-5 as being unpatentable over Murphy in view of Lunde and Renaudin, the Examiner again recognizes that Murphy fails to teach applying a vacuum such that the fiber-reinforced plies do not contact the mold. The Examiner cites to Lunde for its teaching that a vacuum is applied to the interior of the mandrel to aid in wrapping the fiber-reinforced plies around the manual and that the mandrel (with vacuum still drawn, see col. 20, lines 41-60) is placed within the clamshell mold, such that the plies are not in contact with the interior surfaces of the clamshell mold. The Examiner cites to Renaudin for its disclosure of an internal pressure molding process that allows a gap to exist between the internal mold surface and the fiber-reinforced plies (referring to Fig. 6A).

Claim 1, recites, in part, the steps of "inserting a composite body including said internal-pressure holding tube and said prepreg into a vacuum chamber containing a forming die," and "evacuating said vacuum chamber in an isolation state where said composite body and said forming die do not contact each other."

Lunde discloses forming a composite structure by (i) placing multiple layers of fibers over a mandrel body surrounded by a bladder while drawing a vacuum within the mandrel, (ii) placing the uncured composite structure within a clamshell mold, (iii) releasing the vacuum drawn within the mandrel, and (iv) creating a vacuum between the bladder and the clamshell mold such that a pressure differential is created that causes the uncured structure to be expanded against the inner surface of the clamshell mold. (See col. 14, lines 22-32 and col. 20, line 56 – col. 22, line 3.)

During step (ii), as identified by Applicants above, the composite structure might not be in contact with the interior surfaces of the outer clamshell mold. However, during step (ii), a vacuum has not been drawn between the bladder/caul sheet and the outer clamshell molds. Rather, during step (ii) a vacuum is drawn within the mandrel. Claim 1 requires that the composite body has been inserted into a vacuum chamber and that the vacuum chamber is evacuated. Applicants submit

that the vacuum drawn within the mandrel does not teach this limitation of claim 1. Thus, Applicants submit that step (ii) of Lunde fails to teach or suggest inserting a composite body including a internal-pressure holding tube and a prepreg into a vacuum chamber containing a forming die, and evacuating the vacuum chamber in an isolation state where the composite body and the forming die do not contact each other, as required by claim 1.

During step (iv) of Lunde, a vacuum between the bladder and the clamshell mold is created such that the uncured structure is expanded against the inner surface of the clamshell mold. During this step, Lunde discloses a vacuum is drawn in the sealed clamshell mold. However, during this step, Lunde also discloses that the composite structure and the mold are brought into contact with each other when the vacuum is created in the clamshell mold. Applicants submit that step (iv) of Lunde fails to teach or suggest evacuating the vacuum chamber in an isolation state where the composite body and the forming die do not contact each other, as required by claim 1.

Thus, Applicants submit that there is no teaching, suggestion or motivation in any of these cited references, either alone or in combination, for "evacuating said vacuum chamber in an isolation state where said composite body and said forming die do not contact each other," as required by claim 1.

Since all of the limitations of Applicants' claim 1 are not taught or suggested by the combination of Murphy, Lunde and Renaudin, claim 1 is not obvious under 35 USC § 103(a) over this combination. Accordingly, the rejection of claim 1 under 35 USC § 103(a) should be withdrawn.

Claims 2-5 depend either directly or indirectly from claim 1, and also recite additional limitations. Thus, for at least the above-identified reasons, dependent claims 2-5 are also not obvious over the combinations of cited references addressed above. Therefore, the rejection of claims 2-5 under 35 USC § 103(a) should also be withdrawn.

Application Serial No. 10/811,023
Office Action dated September 12, 2006
Response dated December 11, 2006

Applicants believe that no fees are due in connection with filing this Response. However authorization is hereby given to charge Deposit Account No. 13-0235 in the event any such fees are owed.

Respectfully submitted,

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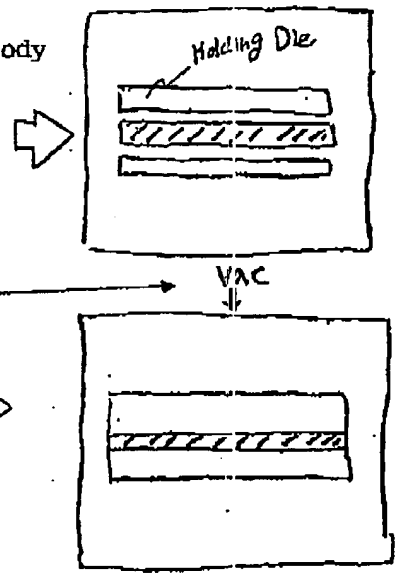
ATTACHMENT

The Present Invention (claim 1)

The forming dies and the composite body (the prepreg and the internal-pressure holding tube) are positioned in the vacuum chamber in a manner that the composite body and the forming dies do not contact each other.

Evacuating the vacuum chamber

In this state, even if the composite body and the forming dies contact each other, the surface of a final product becomes smooth. This is because no air exist.

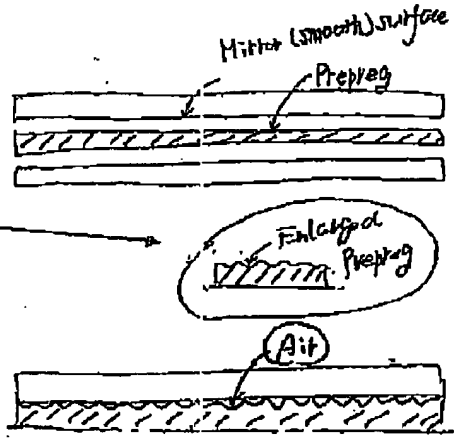


Prior Art 1 (no evacuation)

The forming dies and the composite body (the prepreg and the internal-pressure holding tube) are positioned.

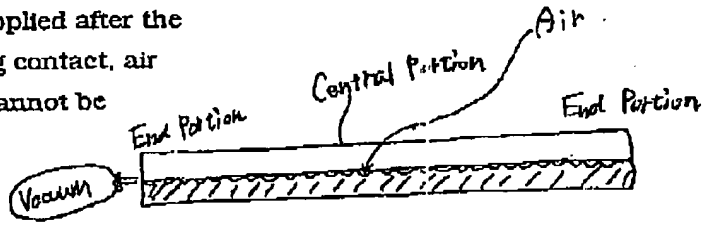
Even if the surface of the molding die is a mirror (smooth) surface, the surface a prepreg is generally a rough surface (refer to the enlarged figure)

When the prepreg is hardened due to the heat applied, spaces (valleys) are undesirably left (formed) between the surface of the molding die and that of the prepreg. The surface of a final product does not become smooth. This is because air exists. Murphy is categorized as Prior Art 1.



Prior Art 2 (Evacuation after the Contact)

Even if vacuum is applied after the molding die and the prepreg contact, air left in the spaces (valleys) cannot be eliminated.



This is because vacuum is generally applied from the end portion of the prepreg, and pressure reduction progresses from the end portion to the central portion. . .

In this case, since the prepreg is soft, the end portion between the molding die and the prepreg is sealed by the deformed prepreg due to the application of vacuum. Then air passage is plugged, and air in the central portion cannot be eliminated.

The surface of a final product does not become smooth. This is because air exists. **Nelson** is categorized as Prior Art 2.

In addition to the above, regarding **Renaudin et al**, as you have developed argument, this cited referenced does not at all disclose anything of "vacuum", let alone evacuating the vacuum chamber. Even if an arrangement is made to apply air from an air passage in the mandrel to inflate the prepreg, air still exists in an area having the length of "d2". Therefore the surface of a final product does not become smooth.